MISSOURI DEPARTMENT OF NATURAL RESOURCES
AIR AND LAND PROTECTION DIVISION
ENVIRONMENTAL SERVICES PROGRAM
Standard Operating Procedures

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SOP TITLE: Quality Assurance/Quality Control for Environmental Data Collection

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SUMMARY OF REVISIONS: The 1999 version of this SOP was modified slightly to conform to current standards.

APPLICABILITY: The QA/QC measures discussed herein may be applicable to personnel who are involved in any type of sampling where verifiable and defensible field and analytical data are required.

DISTRIBUTION: Supervisors, FSS and EERS, ESP
SOP Coordinator
MoDNR Intranet

RECERTIFICATION RECORD:

Date Reviewed				
Initials				

1.0 SCOPE AND APPLICABILITY

1.1 The Quality Assurance/Quality Control procedures discussed herein are applicable to ESP personnel who conduct or oversee all types of sampling activities to obtain environmental data that are of known quality, technically sound, and thoroughly documented.

1.1.1 Quality Assurance (QA) is a system of management activities that involves planning, implementation, assessment, reporting, and quality improvement to insure that all environmental data obtained, and the process by which it was obtained, are of the type and quality that will meet the needs of the client.

1.1.2 Quality Control (QC) is the overall system of technical activities that measures the attributes and performance of the data collection methods used against defined standards to verify that they meet the stated requirements established by the customer.

1.2 The Data Quality Objectives (DQO) Process may be used as part of the Quality Assurance Project Plan (QAPP) development. It provides a systematic procedure for defining the criteria that a data collection design should satisfy, including when to collect samples, where to collect samples, the tolerable level of decision errors for the study, and how many samples to collect.

1.3 The level of uncertainty that management is willing to accept in the results derived for environmental data is described in each QAPP. This uncertainty is used to specify the quality of the measurement data required by the customer, and is usually expressed by data quality indicators such as precision, bias, representativeness, completeness, and comparability.

1.4 Supervisors should insure that each individual has the education, training, technical knowledge, experience, and proper equipment to perform the assigned functions.

1.5 Supervisors should ensure that appropriate methodologies are followed as documented in the QAPPs; that personnel understand their duties and responsibilities; that each staff member has access to appropriate documents; that any deviations from the project plan are communicated to the project management and documented; and that communication between the field, laboratory, and project management personnel occurs as specified in the project plan.

2.0 PLANNING AND FIELD PREPARATION

2.1 Sampling Plan Development [Note: When a sampling plan is not requested, other appropriate guidance documents such as QAPPs, the Hazardous Substance Emergency

Response Plan, and/or Standard Operating Procedures should be followed in lieu of a written sampling plan.] Generally, a sampling plan contains the following items:

2.1.1 The sampling plan should provide general information concerning the requesting agency and the objectives desired. The plan should also provide any available background information concerning the site and suspected contaminants.

2.1.2 The plan should include information concerning the sample locations, the types and number of samples, the methods used for obtaining the samples including the types of containers and equipment that may be needed, and an adequate justification for the data requested.

2.1.3 The plan should, at a minimum, identify those individuals responsible for project management, sample collection, site safety, and sample analysis.

2.1.4 Decontamination of any reusable field equipment should be discussed in the plan when appropriate, and, if hazardous substances are involved, the plan should discuss the handling and/or disposal of investigation derived wastes. See MDNR-FSS-206.

2.1.5 The plan should include the analyses requested, the number and kind of QA/QC samples, and sample handling procedures, including chain-of-custody, packaging, and transportation. See MDNR-FSS-001, -002, -003, and -018.

2.1.6 The plan should include procedures for the final reporting of the analytical data and field observations derived from the sampling event.

2.1.7 A health and safety plan (HASP) should be developed and attached to the sampling plan.

2.1.8 The sampling plan should be reviewed and approved by the Project Manager and/or Project Officer of the requesting agency.

2.2 Pre-field Preparations

2.2.1 Sampling personnel must insure that all sampling equipment is properly cleaned and rinsed, that it is constructed of materials compatible for the analyses requested (e.g. Teflon or glass for VOAs), and that all instruments are charged and operating properly. See MDNR-FSS-200.

2.2.2 Sample containers must be checked to insure that they are of the proper material, that they are new and certified clean, that there is a sufficient quantity of each, and that all additional QA/QC containers and blanks are included. See MDNR-FSS-001.

2.2.3 The sampling personnel must insure that all field documentation requirements are met. See MDNR-FSS-004.

2.2.4 When applicable, appropriate field decontamination equipment shall be included with the other field supplies. See MDNR-FSS-206.

2.2.5 The sampling personnel should insure that all necessary notifications (i.e. Regional Office personnel, Chemical Analyses Section, property owner) are made prior to the field event.

3.0 FIELD ACTIVITIES

The quality of data obtained from the field is to a large degree dependent upon the skill and knowledge of the field personnel who collect the samples. The following are concerns that should be addressed:

3.1 Site Preparations

3.1.1 If hazardous materials are believed to be involved, a health and safety briefing shall be conducted by the designated health and safety officer (generally this is the ESP sample collector) for all individuals needing to enter a site area for purposes related to the sampling activity. The briefing should cover the main concerns outlined in the HASP and be conducted prior to commencing sampling activities. The HASP should then be placed in a location (e.g., taped on the side of the sampling vehicle or posted in the sample staging area) where all individuals entering the site may easily see it.

3.1.2 All field instruments must be calibrated prior to use and details of the calibration procedures shall be documented in a field notebook. See MDNR-FSS-200 and 004.

3.1.3 A suitable work area shall be established for processing forms and sample labels, conducting some field analyses, and packaging samples.

3.1.4 A preliminary site inspection should be made to determine if site conditions or other influences may require deviations from the planned sampling event.

3.2 Site Sampling

3.2.1 All samples should be collected using methods consistent with the plan and appropriate Standard Operating Procedures (SOP). If methods are changed from those described in the sampling plan or appropriate SOP, particular care should be taken in documenting the adopted procedures or methods. See MDNR-FSS-004 through -011.

3.2.2 Sampling equipment shall be constructed of a material that will not physically or chemically alter the material to be sampled. The equipment must be clean and, if applicable, solvent rinsed to help prevent contamination that may alter the data. Dedicated disposable sampling equipment is preferred to eliminate the possibility of cross-contamination.

3.2.3 Regardless of the level of personal protective equipment required at the site, clean disposable nitrile gloves should be worn for each sample collected to help prevent cross-contamination between samples.

3.2.4 Consideration must be given to the order in which the samples are collected. When known, the samples should be collected in order of least contaminated to most contaminated. Also, when known, care should be taken to segregate containers with highly contaminated material (source samples or concentrated samples) from those with uncontaminated or slightly contaminated material (background or water samples) when storing or transporting samples.

3.2.5 Never collect field measurements from a sample container that is intended to be submitted for laboratory analysis.

3.2.6 Every known method should be employed to insure that the sample collected accurately and precisely represents the material being sampled, regardless of the media (i.e. a body of water, an invertebrate population, soil, etc.). Any influence imparted by the sampling effort can effect the representative nature of the sample. Water samples collected from streams for example, should be collected from midstream, with open sample containers facing upstream without disturbing upstream sediment, and far enough downstream of a confluence to allow proper mixing.

3.2.7 Appropriate preservatives must be added either to the container prior to the addition of the sample or immediately following collection of the sample. Extreme care should be exercised when handling sample preservatives as many consist of a concentrated acid or base. In many instances placing the sample on ice is the only preservation required, and again, this must be done as soon as practical following collection. See MDNR-FSS-001.

3.3 Field Documentation

Documentation of all field activities and observations must be thorough and completed in the field with an indelible ink pen while the information is still fresh in the mind of the sampling or data collection personnel. Field records generally consist of bound field notebooks, chain-of-custody forms, sample location maps, photographs, and site safety plans.

3.3.1 The field notebook shall include the times and dates of events, personnel involved, weather conditions, site sketches, calibration procedures, any deviations from the planned procedures, results of field analyses, a description of sampling locations, observations concerning the materials sampled, and all other field activities that may affect the quality of the resulting data. Information concerning photographs should include the number of photographs, the camera type, the lens and setting information, and a short description of each photograph and the direction the photographer was looking. See MDNR-FSS-004.

3.3.2 Identification (sample numbering, description, and tagging) and chain-of-custody procedures (the unbroken chain of possession) are extremely important in insuring that the data presented are true representations of, and traceable to, the sample collected in the field. See MDNR-FSS-002 and MDNR-FSS-003.

3.4 QA/QC Samples

The following are common quality control samples collected by sampling personnel.

3.4.1 A background sample should be collected for each type of environmental media sampled (e.g., soil, sediment, water). There are several considerations that should be taken into account when collecting background samples:

- They must be collected from an area known or expected to be free of contamination.
- As nearly as possible, they should be collected of the same materials as those collected from the site (e.g. if soils are collected from a depth of two feet in alluvium, the background should be from a depth of two feet in alluvial soil).
- Background samples should be collected from upstream, upgradient, or upwind to help exclude known or suspected contamination sources.
- Background samples must be preserved and handled in the exact manner as those collected from the site.

3.4.2 QA/QC samples include trip blanks, field blanks, equipment rinsate blanks, duplicates, spikes, replicate splits, analytical standards and reference materials. At least one replicate split sample or duplicate sample is usually collected per each ten samples, or one per site, if less than ten are collected. The decision making process for determining the number and type of QA/QC samples depends, to a large extent, on the DQOs that are established in the QAPPs, or by the requesting agency.

- Trip blanks and field blanks are analyte-free water samples that are prepared in the laboratory and kept alongside other sample containers throughout the sampling event including sampling, sample preparation, shipping, and storage. Trip and/or field blanks should be included when water samples are to be collected, particularly when volatiles and semi-volatiles are requested for

analyses. Trip blanks are unopened throughout the sampling event and are used to insure that samples are not exposed to contaminants or cross-contaminated during the sampling event. Trip blanks also help document container cleanliness. Field blanks are very similar to trip blanks except they are either opened and exposed to conditions in the field or are transferred to a different sample container in the field during the sampling event.

- An equipment rinsate blank should be collected when sampling or monitoring equipment used for the collection of water data (groundwater or surface water) is decontaminated in the field for reuse. The equipment rinse blank is a sample of analyte-free water that is used to rinse a piece of equipment following the field decontamination procedure and before reuse.
- A duplicate or co-located sample is a sample obtained from the same location, at the same time, and of the same material as the original sample. Duplicate water samples are used primarily to assess precision associated with sampling methodology, and to a lesser extent sample heterogeneity and analytical procedures. Duplicate soil samples are used primarily to determine the variability or heterogeneity of the sampled media. Due to the heterogeneity of soils, caution must be used if attempting to assess precision associated with sampling methodology or analytical procedures.
- A replicate split sample is obtained by dividing or splitting one sample that has been mixed or homogenized into two samples for separate analysis. A replicate split is collected primarily to assess precision associated with analytical procedures and to a lesser extent sample handling procedures. Replicate split samples of soils or other non-aqueous materials are not recommended if volatile organics analyses are requested due to the potential loss of the volatiles during the mixing process. Duplicate samples for volatile organics analyses are sometimes collected prior to mixing, however, there may be a greater potential for inconsistency due to the heterogeneous nature of soils or other non-aqueous media.
- Matrix spikes are samples prepared with known concentrations of a particular contaminant and are used to evaluate the accuracy of analytical procedures at a laboratory or between two laboratories. Field matrix spikes may also be used to evaluate the effects of sample handling, shipping, and storage of a particular contaminant when compared to a laboratory matrix spike of the same contaminant.
- Analytical standards and reference materials are used to calibrate field instruments and check analytical procedures.

Appendix A provides additional definitions and descriptions of the QA/QC samples commonly collected by ESP field personnel.

3.5 Sample Packaging, Storage, and Transportation

The packaging, storage, and transportation procedures are important to insure that the samples remain in, as nearly as practical, their original condition and that they arrive at the laboratory within the holding times allowed for the analyses requested. See MDNR-FSS-001 and MDNR-FSS-018.

4.0 POST FIELD ACTIVITIES

4.1 Returning Samples After Hours

Procedures have been established for securing samples returned from the field after normal business hours and on weekends to maintain custody requirements. See MDNR-FSS-018.

4.2 Records Management

All original chain-of-custody documents are maintained in the Environmental Services Program, Chemical Analyses Section. All other field related documents remain in the custody of the sampling personnel. For most sampling projects, a formal report will be written by the individual responsible for the field activities which will include, at a minimum, an introduction, a methods section, an observations section, and a results section. Maps, photographs, and all other supporting documentation will also be attached to the report as appendices. The report will then be reviewed for accuracy and signed by the program director. For EER incidents, this same information may be included as an addendum to the Incident Report.

5.0 REFERENCES

- MDNR, Field Services Section SOPs.
- Section 3.2, “Field QA/QC Considerations”, Guidance for Performing Site Inspections Under CERCLA, EPA/540-R-92-021, September 1992.
- EPA Guidance for Quality Assurance Project Plans, EPA/600/R-98/018, February 1998.
- EPA Guidance for Data Quality Assessment, EPA/600/R-96/084, January 1998.
- EPA Guidance for Data Quality Objectives Process, EPA/600/R-96/055, September 1994.
- EPA Guidance on Data Quality Indicators (QA/G-5i), Draft September 2001

Appendix A

Environmental Services Program
Standardized QA/QC Sample Terminology

What follows is an attempt to define standard terminology for use by ESP personnel when referring to QA/QC samples that are collected in the field. For the purposes of this document there was no attempt made to define terms in the context of laboratory QA/QC samples. Also, the WQMS may use different terms in the context of biological samples. The following samples are used for quality control purposes and are not used for enforcement nor are they averaged with the true sample.

Water Samples:

Duplicate - A duplicate is a sample obtained from the same location at essentially the same time as the true sample. The procedures used to collect both the true sample and the duplicate sample should be identical. The true sample and the duplicate sample are analyzed for the same set of parameters. A duplicate water sample is used primarily to assess precision associated with sampling methodology and to a lesser extent sample heterogeneity and analytical procedures. A duplicate is not the same as a replicate split, which involves collecting a sample and then dividing or splitting it into two samples. Generally the first sample collected is the true sample and the second is the duplicate. Examples of duplicate water samples include:

- Two ISCO samplers set up side by side to collect composite samples from a stream. The duplicate samples are collected independently of the true sample, but are collected and handled using the same set of procedures used for the true sample.

- Two samples of potable water collected at essentially the same time from the same tap or spigot. The samples are collected directly into appropriate sample containers and are handled and analyzed as two separate samples.

- Two samples of groundwater collected from a monitoring well using a pump or bailer if the samples are collected back to back. In other words, if one set of sample containers is filled first (true sample), and then the second set of samples containers is filled (duplicate), then the sample is a duplicate.

- Two samples of water from the middle of a creek are collected directly into appropriate sample containers from essentially the same location and at the same time. If a water sample were first collected in a bucket and then poured into two sets of sample containers, then the sample would instead be called a replicate split.

Replicate Split – A replicate split is obtained by dividing or splitting one sample into two or more samples for separate analysis. A replicate split is collected primarily to assess precision associated with analytical procedures and to a lesser extent sample handling procedures. Examples of replicate split water samples include:

- Two samples of groundwater collected from a monitoring well using a pump or bailer when the samples are collected by alternately filling the sample containers for each sample. For example, the true sample (sample A) needs three containers filled – A1, A2, and A3, and consequently the replicate split sample (sample B) needs three containers filled – B1, B2, and B3. Containers A1 and B1 will be analyzed for one set of parameters. Containers A2 and B2 will be analyzed for another set of parameters, and so forth. A replicate split is collected by "splitting" the sample from the sampling device (either the bailer or the pump) and then filling containers A1 and B1 first, followed by filling A2 and B2, and finally A3 and B3. Which sample is called the true sample and which is the replicate split is immaterial, but must be done in the field at the time the Chain-of-Custody Record is completed.

- Two samples of wastewater are split from one composite sample that had been collected by an ISCO wastewater sampler.

Analytical Replicate – An analytical replicate is a sample that is returned to the laboratory where up to three analytical replicates may by run for separate analysis. This is primarily a laboratory term but is used on occasion by WQMS staff when analyzing fecal coliform samples.

Soil Samples:

Duplicate - A duplicate is a sample obtained from the same location at essentially the same time as the true sample. The procedures used to collect both the true sample and the duplicate sample should be identical. The true sample and the duplicate sample are analyzed for the same set of parameters. A duplicate soil sample is used primarily to determine the variability or heterogeneity of the matrix. Unlike water, which is a relatively homogeneous matrix, soil is heterogeneous. Due to the heterogeneity of soils, caution must be used if attempting to assess precision associated with sampling methodology or analytical procedures with results obtained from soil duplicate samples. Duplicate samples for volatile organics analyses are sometimes collected prior to mixing, however, there may be a greater potential for inconsistency due to the heterogeneous nature of soils.

A duplicate is not the same as a replicate split, which involves collecting a sample and then dividing or splitting it into two samples. Generally the first sample collected is the true sample and the second is the duplicate. Examples of duplicate soil samples include:

- Two samples collected from the same excavated soil pile. The samples are collected using the same methodology and equipment but are collected independently and are never mixed together. However, any equipment that is not dedicated should be decontaminated between samples. The samples do not necessarily have to be collected adjacent to one another, but must be collected from the same population (e.g. the soil pile).

- Two soil borings collected in close proximity to one another (generally 1 to 3 feet apart) using the same methodology and equipment but are collected independently. Any equipment that is not dedicated should be decontaminated between samples. This type of QA/QC sample is sometimes referred to as a co-located sample.

Replicate Split - A soil replicate split is obtained by mixing or homogenizing a sample (either a grab or composite) and then equally dividing, or splitting, that sample into two samples for separate analysis. The key difference between a duplicate sample and a replicate split sample is the mixing or homogenization process that is done for a replicate split. While a duplicate sample is used primarily to assess the heterogeneity of a soil matrix, the replicate split sample is used to assess precision associated with analytical methodology and sample handling procedures. As with a water sample, it doesn't matter which sample is called the true sample and which sample is called the replicate split, but the decision should be made in the field and must be made at the time the Chain-of-Custody Record is completed. Replicate split samples of soils or other non-aqueous materials are not recommended if volatile organics analyses are requested due to the potential loss of the volatiles during the mixing process.

Hazardous Waste Samples:

In general QA/QC terms, liquid waste samples should be treated like water samples, and solid waste samples should be treated like soil samples. The decision in whether to call a QA/QC sample of hazardous waste a duplicate or a replicate split lies in how the sample is processed at the time of collection. If two samples of hazardous waste are independently collected from the same source (e.g. a 55-gallon drum, a storage tank, or a waste pile) at essentially the same time, using the same methodology and equipment and the samples are not mixed for homogenization in any way, then a duplicate sample has been collected. If two samples are obtained by splitting a sample after it has been collected from the original source, then a replicate split sample has been collected.

Blank Samples and Spikes:

Field Blank - Field blanks are prepared in the field by filling the appropriate sample container with certified clean sand or soil or distilled/deionized water, depending upon the matrix of interest, and are handled, preserved and analyzed in the same manner as other samples. Field blanks are collected to ensure that nothing from the environment (essentially air pollution) is contributing to contamination of a sample (generally a water sample for VOA). The ESP does not collect many field blanks.

Trip Blank - Trip blanks are prepared in the lab prior to going into the field when primarily VOA and/or BNA water samples are to be collected. Trip blanks are used to evaluate contamination error associate with sample handling or shipment, or lab handling or analysis. The trip blanks are not opened or otherwise manipulated in the field. Any preservatives that may be used, such as HCl for VOAs, will be added at the laboratory prior to going into the field.

Rinsate Blank - Rinsate blanks are samples obtained by pouring analyte-free water over decontaminated equipment to test for residual contamination.

Matrix Spikes - Matrix spikes are samples prepared with known concentrations of a particular contaminant and are used to evaluate the accuracy of analytical procedures at a laboratory or between two laboratories. Field matrix spikes may also be used to evaluate the effects of sample

handling, shipping, and storage of a particular contaminant when compared to a laboratory matrix spike of the same contaminant.

Analytical Standards - Analytical standards and reference materials are used to calibrate field instruments and check analytical procedures.

True Sample - Whenever a replicate split or duplicate sample is collected, the true sample is the main or primary sample. The terms “main”, “primary”, or “routine” are sometimes used as synonyms for a true sample, but for the sake of standardization their use should generally be avoided. The true sample must be designated prior to analysis, and is usually designated at the time the Chain-of-Custody Record is completed.